Maritime Studies
a SpringerOpen Journal

RESEARCH Open Access

Negotiating risk and poverty in mangrove fishing communities of the Bangladesh Sundarbans

Mohammad Mahmudul Islam[1*] and Ratana Chuenpagdee[2]

* Correspondence:
m.islam@uni-bremen.de
[1]Bremen International Graduate School for Marine Sciences (GLOMAR), Research Center for Sustainability Studies (artec), University of Bremen, Bremen 28359, Germany
Full list of author information is available at the end of the article

Abstract

Small-scale fishers in Bangladesh face substantial risks due to their occupation and their geographical setting. Without any effective buffer against crises, recurring shocks and on-going risk exposure are major factors pushing fishers into poverty. Not all fishers experience these events in the same way, however, with some of them showing higher capacity to negotiate risks. In this study, we ask how fishers cope with shock, what factors differentiate them in their risk negotiations, and what implications these factors may have on poverty alleviation policy. On the basis of the study's findings, we posit that poverty alleviation in small-scale fishing communities in Bangladesh requires interventions that target not only risk minimization, but also the endowment of fishers with socio-economic capitals to help them handle varying degrees of risk and shocks. Such policies as, for instance, providing employment for fisherwomen or providing a basic social safety net will increase the overall resilience and well-being of fisher communities.

Background

Sea fishing has long been considered a risky profession due to natural hazards and technological failures (Smith 1998). High occupational hazards such as accidents while hauling in nets (Lincoln et al. 2002), health risks such as those from disease (Kissling *et al.* 2005), substantial variability in catch and consequent uncertainty in financial return (Salas et al. 2011), market risks such as increases in fuel price (Andrade and Midré 2011; Edvardsson et al. 2011), and political and security risks such as theft and conflicts (Béné and Friend 2009) reinforce this claim. The situation is likely to be further accentuated in the future by climate-related risks (Allison et al. 2009; Chuenpagdee and Juntarashote 2011). Poor fishers and their families in less developed and developing countries are more affected by most of these risks than those in developed countries because they have fewer means to cope with shocks and the aftermath of exposure to multiple risks (cf. Sinha et al. 2002; Fafchamps 1999).

Cashdan (1985: 455) refers to risk as the probability that "an unpredictable loss will occur." Shock, on the other hand, is the "manifestation of risk" (Hoogeveen et al. 2004: 4), or the "adverse events that lead to a loss of household income, a reduction in consumption and/or a loss of productive assets." (Dercon et al. 2005: 563). In Bangladesh, risks and subsequent shocks are perceived to be ubiquitous in the livelihoods of the coastal poor, but surprisingly few researchers have examined them. As argued by Hoddinott and Quisumbing (2010), the understanding of risks, shocks and their consequences is a

necessary, though not sufficient, step in the design of immediate interventions and short-term programs to minimize their impacts. Dercon (2010) further posits that such understanding has crucial implications for appropriate long-term policy responses, like building social safety nets for the poor. An investigation of the role that risks and shocks play in inducing vulnerability and poverty in people's livelihoods, and of the complexity of their risk negotiations, is therefore needed in order to fine-tune policies and interventions.

A study of risks and shocks in the context of small-scale fisheries in the Sundarbans mangrove forest is highly relevant because of the dangerous and insecure natural environment and the fact that nearly everyone is dependent on fishing as the main, if not the only, basis for livelihood. Seasonality is a phenomenon that the fishing people need to navigate on a regular basis, while facing recurring natural disasters. Markets function poorly and social safety nets (such as the Vulnerable Group Feeding program[a]), even though present for a few, are not able to guarantee support when needed. Our early field observations of the fishing communities in this area revealed, however, that not all members in the fishing communities are exposed to risk and experience shocks in the same way. They also vary in how they can negotiate risks. Using a case study approach, we conducted in-depth research in the Sundarbans mangrove forest from November 2009 to April 2010, with a follow-up field visit in August 2011 to examine the following topics: i) the risks and shocks faced by the various members of the fishing communities in the Sundarbans; ii) the consequences these events have on their well-being; iii) how fishing households cope with risks and shocks; iv) the factors that foster coping mechanisms of some groups but inhibit those of others; and v) what can be done to enhance the coping capacity of the latter groups and to mitigate overall impacts due to risk exposure and subsequent shocks.

The paper is structured as follows. First, we conceptualize risks and shocks in the context of the well-being of individuals and households. Next, we describe data collection methods and the study areas. This is followed in section three by an overview of the fisheries practiced in the Sundarbans mangrove forest and the socio economic features of the resource users of the forest. Subsequently, we present the empirical data to describe different shock exposure and coping strategies and factors that foster or inhibit coping mechanisms. We conclude with a discussion of ways to enhance fishers' coping abilities and the policy implications of our research.

Concepts of risk and shock

Risk is generally understood as the "presence of a potentially large number of different possible circumstances that may materialize at a particular moment in time in the future" (Dercon 2010:15). Following Tingley et al. (2010: 1249), we consider risk as "multidimensional and subjective concept", where a particular risk event has different meanings for different people (The Royal Society 1992 as cited in Tingley et al. 2010). While our study focuses on risk exposure, we note that not all events result in risks, and that shocks can stem from both risk and non-risk events. Non-risk events, like slight price fluctuations of food grains, can also create a shock, such as to poor households who are net buyers of food. Uninsured risks and unmitigated 'shocking' experience of these risks can lead to adverse welfare outcomes and can cause poverty (Dercon et al. 2005).

Risk can be covariate or idiosyncratic. Covariate risk is an aggregated risk such as a flood that affects everybody in a particular community or area. Idiosyncratic risk, on

the other hand, only affects a particular individual in the community such as a health shock (Dercon 2002; Takasaki et al. 2004). Chambers (2006: 33) exemplifies this using the vulnerability framework, which has two sides: "an external side of risks, shocks, and stress to which an individual or household is subject; and an internal side which is defencelessness, meaning a lack of means to cope without damaging loss." This framework helps to understand the relationships between risk management and vulnerability to poverty of rural households in developing countries (Webb and Harinarayan 1999; Tai et al. 2010). We note that vulnerability is not synonymous with risk. While risk is about exposure to external hazards over which people have no or limited control, vulnerability conceptually includes also the capacity to manage such risks without suffering damaging or socially unacceptable loss of well-being (Dercon 2006; Chambers 2006; Hoogeveen et al. 2004; UNDP 2007).

Households generally try to negotiate risk through a range of strategies, which may be *ex ante* (i.e. before shocks occur) or *ex post* (i.e. after shocks occur) (Dercon 2010, Dercon 2002; Morduch 1995, Morduch 1999). These responses have further implications. For instance, among the *ex-post* coping strategies, selling of assets can deplete the scarce resources of households, thus reducing their earning potential and pushing their productivity into a downward spiral. This situation is particularly evident if shocks are recurrent and are continued for longer periods that provide little prospect to household to rebuild their assets (Mendoza 2009).

Risk can be insured. Once risk is insured, it ceases to be a concern as subsequent shocks will not affect welfare outcomes. Both market-based insurance and self-insurance systems can avert negative welfare consequences in the event of risk exposure (Hoogeveen et al. 2004). Uninsured risks lead to poverty in two ways (Dercon 2010). First, as previously stated, risks, and shocks, are costly to individuals and households as they directly result in income loss. Second, a household or households' response to risk for some additional protection against shocks may come at the cost of income gains (Dercon 2002). For instance, for the fear of total investment loss, poor households may choose to invest in lower risk and lower return choices, and forego risky but higher return production choices (Dercon 2005; Chaudhuri et al. 2002; Morduch 1999). Finally shocks may directly lead to loss of assets (such as death of livestock) that contribute to further poverty (Dercon 2010).

Exposure to risk and resulting shock can also increase entrenched social inequality (Rosenzweig and Binswanger 1993; Dercon 2002). As Mosley and Verschoor (2005: 60) put in "if the poor do not invest and the rich do, gains in enterprise income will be restricted to the rich, with the implication of growing inequality over time." Women and children, particularly girls, are particularly susceptible to shocks. Women usually act as 'shock absorbers' for the household by reducing their food consumption to leave more for other members, notably their children and earning members (Mendoza 2009; Quisumbing et al. 2008). They also supplement household income through multiple jobs, limit spending, and collect foods and fuel from nature to meet the basic needs of their households (Mendoza 2009; Hossain 2009; WFP 2009, as cited in Mendoza 2009). Shocks can cause severe harm to children since families may cut spending and investments on nutrition and education. Poor nutrition in early childhood can lead to long term harm in the forms of stunting and lower cognitive capacity and other persistent health impacts. Adverse health impacts and lack of education can cause intergenerational transmission of poverty (Mendoza 2009; Dercon 2006).

Study areas and methods

The Sundarbans is the largest single tract mangrove forest in the world. It was declared a reserve forest under the forest act of 1855.The Forest Department (FD) of the Ministry of Environment and Forest of Bangladesh Government controls fishing activities by issuing fishing permits to fishers (Hoq 2007). Fishing activities in the Sundarbans are predominantly undertaken by small-scale fisheries. These are labour intensive, low in capital investment, and are pursued for subsistence and commercial purposes or both (Hoq 2007; Rouf and Jensen 2001). Fishing gears and crafts are mostly traditional. Gears include different types of gillnets (such as drift, large mesh, fixed, and bottom set), estuarine set bag nets, trammel nets, beach seines, push nets, drag nets, and many different types of hand-operated gears and traps (Rouf and Jensen 2001; Hoq 2007). Shrimp and prawn postlarvae collection for stocking in local coastal aquaculture ponds can be considered as the largest fishing activity in terms of number of people involved. About 70–75 percent of the households living along the rivers and creeks of the Sundarbans are engaged in this activity. Mixed species of white fish, crab (*Scylla serrata*), Hilsha (*Tenualosa illisha*), and *Golda* (*Macrobrachium rosenbergii*) are the most economically important species (Rouf and Jensen 2001). The Sundarbans provide a major source of livelihoods for about 200,000 fishers (Hoq 2007).

The livelihoods of resource harvesters of the Sundarbans are characterized by high levels of income poverty and human development poverty. Most of them have limited access to basic social services, such as safe drinking water and healthcare. They also lack knowledge of health and sanitation practices. Most of them suffer long term debt bondage and face exploitative relations with moneylenders. They generally lack organizational skills, do not have professional memberships, and have a muted voice in decision making. Infrastructure is poorly developed and access to markets is restricted. Women are particularly underprivileged and marginalized, with minimum access to income, livelihood opportunities, education, and healthcare. Moreover, there is no mobilization and organization of the Sundarbans resource extractors in order for them to be recognized as stakeholders in the management of the Sundarbans (Mitra 2000; Asian Development Bank 1998). Large income inequality between better off and poor households is another feature. Incomes of the richest households are six times higher than those of the poorest groups. Agricultural land ownership is extremely skewed, with only 51 percent of the population owning land. The average household size in the impact zone is 6.3 persons and the literacy rate is 36.5 percent (all data in the preceding sentences from Mitra 2000).

The study was conducted in the three fishing communities (Figure 1) of Mothurapur, Chandipur and Dumuria villages in the edge of the Sundarbans mangrove forest within Shymnagar sub-district of Satkhira. The fishing village in Mothurapur is located in Munshigonj Union[b] on the coastal embankment bordering the river that separates coastal land from Sundarbans forest. It consists of lower caste Hindus of 53 fishing households. Infrastructure in the Mothurapur village is poorly developed, with no electricity and an inadequate sanitary system. Fishermen are mostly involved in beach and shore seine net fishing, whereas fisherwomen collect postlarvae of shrimp and prawn. Some women also do labour work, such as digging land for soil and using the soil for nearby road preparation and maintenance. The fishing hamlet Chandipur is situated in Buri Goalini Union. The community has 36 lower caste Hindu fishing households and is situated close to a paved road that leads to the district headquarters. Most fishermen

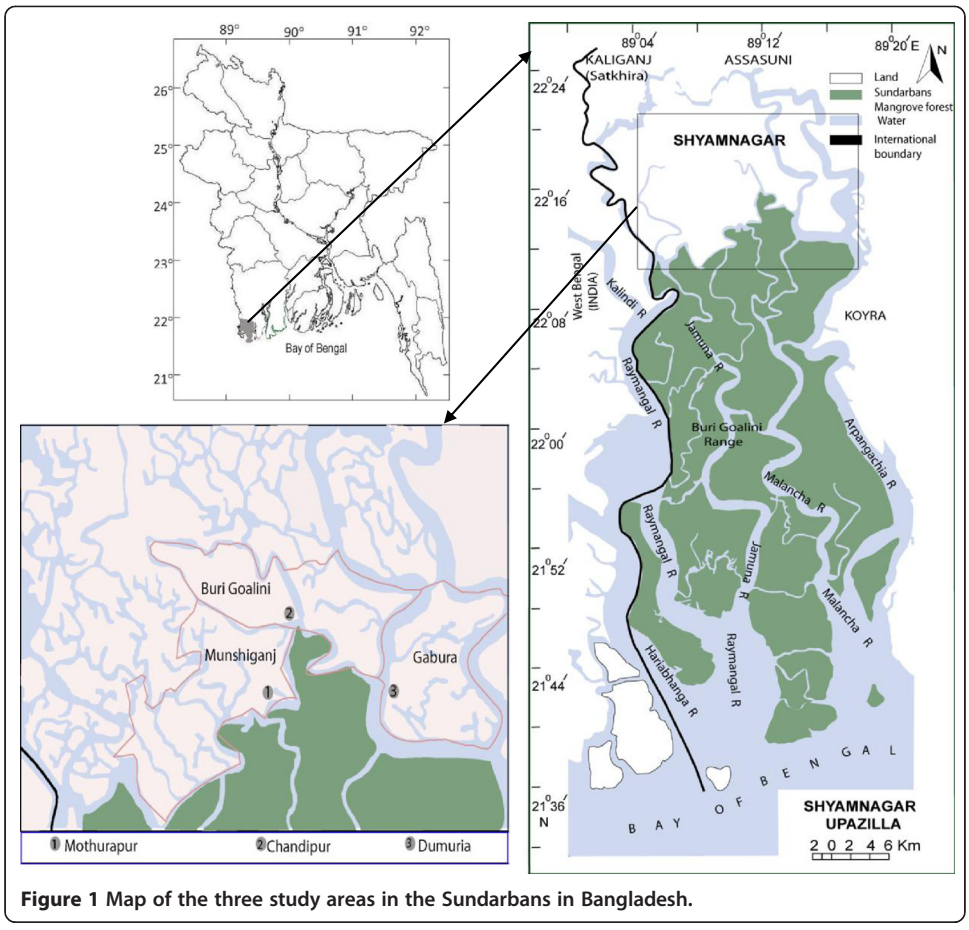

Figure 1 Map of the three study areas in the Sundarbans in Bangladesh.

are involved in beach seine and shore seine net fishing, but some fishermen also collect crabs. A number of fishers engage in marketing activities. Women are housewives but some do the same labour work as fisherwomen in Mothurapur. The fishing hamlet Dumuria is situated in Gabura Union, which was badly affected by cyclone Aila in May 2009. The first phase of the study was conducted soon after the cyclone and all households were largely dependent on food and water rations as food sources and health and sanitation facilities were almost totally destroyed. We interviewed 30 Muslim fishing households in Dumuria. Fishers in this area collect shrimp and prawn postlarvae, and are also involved in crab collection.

Data were collected through individual and key informant interviews, as well as participatory observation from November 2009 to April 2010, with a follow-up field visit in August, 2011. Interviews were done using a semi-structured questionnaire, consisting of questions regarding household characteristics, possessions and productive assets, target species and gear used, risk perception, risks and shocks faced during fishing and in daily life, and coping strategies. In total, ninety five interviews were conducted, eighty of which were with fishers (both men and women). The rest were with people involved in post-harvest activities and credit markets, some forest officials and non-governmental organization (NGO) officials. Each individual interview lasted about 45 minutes on average. As fishers felt uncomfortable with tape recording, the responses were hand-written by a research assistant. In Mothurapur, the majority of the

interviewees were women, while in Chandipur, both men and women were interviewed. In the case of Dumuria, the interviewees were all males from 30 households who had taken temporary shelter on coastal embankments after their village was devastated by the cyclone. Additionally, twenty key informant and in-depth interviews were conducted with some knowledgeable and interested persons who wanted to give more information. Supplementary to the interviews, we reviewed secondary data sources, mainly daily newspapers and reports published by NGOs. This secondary data was particularly helpful in providing information about rehabilitation activities after cyclone Aila, and about illegal and unlawful activities that take place in the Sundarbans. Handwritten data were transcribed with the help of a research assistant. After transcription, content was analyzed and classified into different themes for theoretically-guided analysis.

Results

Shock-ridden fishing communities in the Sundarbans

> "We have crocodiles in the water, tigers on the land and dacoits[c] on the boat but nobody is there to heed our grief."
> A fisherman from Chandipur.

This section utilizes empirical data gathered by our research to describe the livelihoods of the fishers of the Sundarbans with an emphasis on the events that create shock exposure and on the factors that mediate shock impacts. These events and factors are presented in Table 1.We also provide examples to illustrate the consequences of risks and shocks on the fishing livelihoods of the Sundarbans. Fishing activities in the Sundarbans are characterized by a peak week (*goon*) of good harvest, followed by a lean week (*bhati*) of poor harvest, caused respectively by spring tide and neap tide cycle. Fishers normally do not go out to the forest during lean weeks, thus fishing is limited to two weeks in a month. Most fishers go out once a day for only three to four hours because of tidal variation. Shrimp and prawn postlarvae collectors, on the other hand, fish twice a day. Extending the fishing period is not possible as high tidal water may damage the fishing gear and wash away the harvest. In addition, fishers are susceptible to natural fluctuations in catch. One fisher from Mothurapur described the situation:

> Fishing is like a lottery- catch varies from day to day, one week to another. Maybe in one day you get bumper catch, but on subsequent days you may suffer poor or even no catch.

Unexpectedly poor catches or harvest failure in a single peak fishing week is a blow to the income of the fishing households. The shock becomes severe when poor harvests are recurrent for more than one peak period, or when fishers are forced to discontinue fishing due to the number of other reasons such as bad weather or tidal surges in the monsoon season.

Income from fishing may be further dissipated by illicit acts, such as ransom by dacoits and bribery by forest officials. Dacoits rob collected fish and crab, nets and even boats, and often kidnap fishers or physically attack them. At least 20,000 BDT (about

Table 1 Events that create shocks, factors that mediate shock exposure, and strategies to address shock impacts (Based on interviews with fishers and participant observation in the Sundarbans)

Events that create shock exposure	Factors that mediate impacts of shock	Strategies to address shock impacts
Risk events		
i. Cyclones and other extreme climatic events	i. Ownership of land and other productive assets, such as fishing gear and craft	i. Adjusting labour supply and using children as labour
ii. Physical accidents during fishing	ii. Gender differences in family headship	ii. Shifting to non-fishing occupations
iii. Tiger attacks	iii. Demographic characteristics of family and dependency ratio	iii. Diversification of fishing occupations
iv. Attacks by criminal gangs	iv. Diversification of target species, fishing gears and fishing methods	iv. Changes in target species and fishing gear
v. Illegal rent seeking (ransoms, bribes)	v. Access to information networks and alliances with powerful individuals	v. Illegal and or unsustainable extraction of fisheries and other wood and non-wood forest resources
vi. Food insecurity and drinking water crises	vi. Risk perception	vi. Family cooperation and consumption adjustment
vii. Illness and health problems	vii. Type of risk	vii. Taking loans from neighbours and network
viii. Legal procedures after breach of regulations		viii. Informal mutual supports and mutual insurance
ix. Social exclusion due to tiger widowhood		i. Trust, reciprocity and kinship
		ii. Occasional migration
		iii. Rituals and beliefs
Non-risk events		
i. Price fluctuations of fish and food		
ii. Seasonality and harvest failure of fish catch		
iii. Credit inaccessibility		
iv. Changes in land usage pattern (e.g. aquaculture)		
v. Costs due to marriage and dowry		
vi. Resettlement		

245 US$) is claimed as ransom for each kidnapped fisher. Some fishers are killed by dacoits each year; numerous fishers are wounded, and their families become bankrupt as a consequence. A number of ex-fishers said they left fishing because of dacoits and are now doing van[d] pulling. With respect to bribery, fishers have to pay a certain fee for getting permits to fish in the forest. This management rule allegedly involves corruption, as fishers claim that they need to pay ten to fifteen times the amount of the actual fees for the permit. They may also need to bribe forest officials at different checkpoints when staying in the forest longer than the permitted period. Khuda (2008: 6) estimates that forest officials in the Sundarbans extort around 2.3 million BDT (about 28,400 US$) per year from fishers. The different forms of rent dissipation are explained by a fisher in Mothurapur as follows:

> Income from fishing in the Sundarbans goes to seven[e] families. You have to give bribes to forest officials to secure a permit for fishing, extortion or ransom money goes to dacoits, weightier (a person who weighs catch at landing sites) and commission agents will demand extra money at the fish landing centre, then *mohajan* (money lenders) may come to the scene to claim money.

To recover these additional expenses, fishers usually resort to illegal fishing, as well as illegal logging, creating thus a vicious circle of overexploitation and corruption. When fines are given to fishers for illegal activities, they add another shock to household's income. Fishing permits may be revoked and fishers have to take frequent trips to the district headquarters to pursue legal procedures, all of which involve money and time, and increase exposure to bureaucratic harassment.

For most of the interviewed households, the collection of shrimp and prawn postlarvae is a very important income supplementing activity for fishing families. The price of these products depends, however, on the cycle of shrimp aquaculture. During the off-peak season, demand for postlarvae is less, and the price may drop to about half of that received during the peak season. Thus their daily income maybe lowered from two American dollars to one dollar. Despite the regularity and predictability of these price fluctuations, they pose a shock to marginal fishers with very low income. Since most of them are net buyers of food and other daily necessities except fish, fluctuations in food prices also have profoundly negative impacts on family consumption, thus raising their food insecurity (cf. Mendoza 2009). The dilemma of price declines and food buying is complex. One may question why fishers need to buy food rather than consuming more of the fish that they catch. In this particular case, it is not only that shrimp and prawn postlarvae are non-consumable fish products, but it is also rice, not fish, that is their staple food. Price instability of necessary daily commodities is an added ingredient to their vulnerability. Fishing households in our study areas spend more than sixty percent of their daily income on food. This situation drastically reduces their capacity to invest or save for future needs. After exposure to different shocks, fishers are in dire need of money to keep their families afloat. The formal credit market is poorly supplied, and in most instances excludes small-scale fishers from benefiting due to absent or insufficient collateral in the form of assets. Taking loans from money lenders is also risky because failure to repay the loan may force the sale of remaining productive assets, such as boats and nets. As our study reveals, several fishers absconded in order to avoid or delay repayment of loans from NGOs and money lenders.

Fishing activities in the Sundarbans take place mainly in narrow canals and tributaries where territorial use of space often creates conflicts and tension. This is particularly the case with estuarine setbag nets for shrimp and prawn postlarvae collection, where theft or destruction of gear by other users takes place. Additionally, small-scale fishers compete for space with coastal aquaculture. Canals and water-logged agriculture fields in the rainy season, earlier used by poor fishers for their livelihood activities, have been turned into shrimp ponds. Discharge of farm effluents containing hazardous substances together with overfishing by shrimp and prawn postlarvae collectors has drastically reduced fisheries productivity in the remaining freshwater bodies (Islam and Wahab 2005). Much *khas*, or government-owned land around coastal embankments, which had been used by the poor for their settlements, now has become the private property

of aquaculture entrepreneurs. The expansion of shrimp aquaculture has thus removed a buffer for the livelihoods of many marginal fishers. One fisherwoman from Mothurapur recalled:

> Even by digging up holes made by rats in paddy fields, we could collect the remains of paddy that ensured our food security for at least two months. We worked in the paddy field during harvest seasons and payment of the labour was in grains rather than in cash and that was positive for our food security. We could even use collected paddy chaff for fuel, for thatch or food for cattle. Now we have to travel long distances inland to find a paddy field to work on, because all farm land nearby has been converted into aquaculture ponds.

Another issue related to shrimp farming is environmental quality. In Dumuria, a number of fishers mentioned that before shrimp aquaculture was initiated, they could drink groundwater and cultivate vegetables and fruits in their home yards. Now, one fisher from Dumuria said:

> Only in the rainy season can we drink rain-harvested fresh water, the rest of the year we have to drink water from ponds after purification or buy water, because ground water is too saline to drink.

Health problems often constitute a significant shock in fishing communities. Women and children who use drag nets to collect shrimp and prawn postlarvae, need to spend five to six hours per day in the water. These uncomfortable working conditions affect their health. Skin diseases and gynecological problems are reported for women and young girls who work as collectors. Many fishermen are distressed by infestations of mosquitoes. One fisherman from Chandipur said that:

> Mosquito bites in the forest are so harsh and acute that sometime I feel that begging on land is better than fishing in the forest.

Moreover, village settlements are highly congested and sanitation facilities are poorly developed. Many households still lack sanitary toilets, exposing them to risk of water borne disease. Illness of a family head and main income earner is one of the most cited causes of shock. Although almost all members in fishing households contribute to family income, illness of one earning member can put them in a situation where they are unable to meet the costs of treatment. Their welfare is highly affected because they usually have little or no savings to fall back on. Even for some better off households, they risk becoming bankrupt, as they have to sell assets to meet high treatment costs. Many fishing households are living in the condition that Krishna (2010:17) describes as "only one illness away from poverty".

A number of shocks also emanate from extreme natural events. Fishers are killed each year in the seas adjacent to the mangrove forest due to hostile weather conditions. In Dumuria, during cyclone Aila, coastal embankments protecting the island from tidal water were destroyed and washed away, along with vast swaths of agricultural land, shrimp farms, and homes. Many better off households were able to leave the island, while the rest stayed in temporary tents on the remaining wrecked coastal embankments. After more than one year, they went back to their homes but torrential rain in

2011 again flooded their village. In our study areas, some households needed to shift their houses four times due to erosion. With a very limited asset base, a one time shift of settlement is already beyond their coping capacity. The accompanying loss of livestock, paddy fields, and other food sources seriously worsens local food security. In this particular circumstance, a vicious circle occurs as the non-fishing families, or non-fishing members of fishing families are pushed into fishing due to limited income generation options elsewhere. Going to the forests for maintaining livelihoods is often considered an activity of last resort, as a local proverb says:

> *Nirdhon*? *Jao bon*- No assets? Then go to the forest.

One key informant noted that since cyclone Aila the number of men entering and working in the forests has constantly increased. The Government of Bangladesh, after cyclone Aila, put a ban on wood collection in the Sundarbans to enable mangrove regeneration. For this reason, many former wood collectors enter into fisheries, thereby increasing pressure on the fisheries resources.

The Royal Bengal tigers that roam the Sundarbans are an impending risk for resource harvesters. In the last thirty years, 14 people have been killed in Chandipur and 10 people in Mothurapur study areas. According to the Forest Department of the Government of Bangladesh, tigers killed 120 men in 2009 alone, or about one every three days. Some fisherwomen were also killed while fishing inside the forest. Some deaths go uncounted, however, because the documentation applies only to victims who are officially registered forestry workers. The government normally provides a lump sum of 100,000 BDT (1240 US$) per person to the families of victims but getting this compensation often involves bribery and suffers delays. More than 1,000 women are recorded who have lost their husbands in tiger attacks in the Sundarbans (Kazim 2011). Commonly referred to as "tiger widows", these women have become a symbol of misfortune in the village and in their in-law's houses. Sometime they are ill treated after the deaths of their husbands (LEDARS 2010). One tiger widow from Chandipur recalled her sad experiences:

> After the death of my husband by a tiger attack, my miserable life started. I took shelter in my parents' home with my two kids. Working in a shrimp farm, sorting shrimps, only gives me 40 BDT (50 US cents) per day. The number of meals per day decreased; quite often I skip my meals to give some food to my children.

Misfortune also haunts the children of tiger widows. They may face harsh words from their classmates, for instance, that their fathers were killed because they were "bad" men. Because of such treatment and because of their poverty, many children leave school and try to eke out a living by engaging in labour work that earns them little income. Without education and other support, male children eventually turn to the forests, like their deceased fathers, putting themselves thus at the same risk (Kazim 2011; LEDARS 2010). Further, human activities also play role in intensifying certain risk activities in the forest. For instance; one key informant (an NGO official who is working with tiger widows) noted that:

> Human activities largely influence the behavior of tigers. People are fishing and poaching in no-take-areas in the Sundarbans, thus the habitats and food sources of tigers are largely ransacked. Now tigers are roaming larger areas in the forest in

> search of food and attacking forest-goers. Day by day incidents of tiger attack and trespassing into nearby villages are increasing. Yet, the tiger is an integral part of resources management of the Sundarbans. If there were no tigers, the Sundarbans would perish within twenty years due to over-exploitation and illegal exploitation.

The socio-cultural setting of the communities also increases the impacts of their risk exposure. Although both poor and better off fishers are affected by dacoits, the poor suffer more and experience more profound shocks. Shocks are particularly biased towards women in the households or women-headed households in the fishing communities. Women and girls are usually involved in fishing practices that are time consuming, such as using drag nets for collecting shrimp and prawn postlarvae, for erratic and meager returns[f]. Women are usually assigned to the less strenuous parts of manual jobs and get seventy percent of the wage of their male counterparts, despite their ability to do more. Limited scope for income generation as well as wage differentiation put women-headed households at the lowest income level in the communities. Girls become a family liability due to the practice of dowry. Marriage of girls was thus a common shock for almost all households interviewed, even though it is not totally unanticipated when baby girls are born. Wedding-related expense may also push households into bankruptcy. In their study in rural Bangladesh, Baulch and Davis (2008) find that dowry represents the largest sum of yearly lump expenditure (35%) for households, and wedding expenses are higher in a bride's family (23%) than in a groom's (21%). Thus the number of girls in a family makes the family more vulnerable. Due to dowry and other reasons like childhood marriage, the rates of divorce and wife abandonment are increasing in fishing communities, some fishers indicated.

In sum, for most fishing households, shocks are recurrent, cumulative and transferable to subsequent generations. Fishing households may suffer several shocks within a short period rather than a single one. This exposure to consecutive shocks makes their livelihoods precarious: "a single blow can be endured by most people, but when several blows fall one after the other, then it becomes very hard for any individual to cope" (Krishna 2010: 18). Recurring shocks make them very vulnerable to further risks, which may push them into extreme poverty or diminish their opportunities to get out of poverty. Yet, as exposure to shocks and impacts of shocks are not uniform for all fishers, responses also vary accordingly. The next section focuses on different coping strategies of fishing households in response to different shock impacts.

Coping strategies of the fishing households

For fishing households in the Sundarbans, reduced consumption is the first strategy to deal with crises of no or insufficient income. Usually the head of family and income earner gets the first priority in terms of access to limited food, with women having the last priority. The proportion of cheaper vegetables increases with the reduction of rice in daily consumption during periods when prices increase. Taking rice and other daily necessities on loan from next door neighbours is also a common strategy to smooth consumption. Diversified economic portfolios are another strategy of coping. For instance, women collect shrimp and prawn postlarvae as their main gainful activity, but also work in shrimp farms, weed grass from agriculture fields, collect paddy, mend and prepare nets, collect mangrove leaves for fuel, prepare traditional quilts, work as

housemaids, and prepare and sell charcoal from mangrove wood. Another dominant strategy is to remove children from school; boys are put to work in fishing jobs, even though they receive lower wages than adults. Similarly, girls join in collecting shrimp and prawn postlarvae. The reasons for child labour are explained by one fisherwoman from Mothurapur:

> There are always income opportunities in the forest, if they can catch a big crab and sell it at BDT 80 (1 US$), then I can buy two kilograms of rice. Rather than starving with children, better to earn with them.

The multi-species fisheries of the Sundarbans also offer job flexibility in terms of target species. During our study period, we observed that most interviewed fishers converted from catching fish species to harvesting crab because fish catches had declined, while the price of crabs rose. Crab collection also requires less labour power (only two persons) and it faces less risk of tiger attack. This coping strategy of changing target species was at first not taken up widely by lower caste fishers who, with their strong hereditary profession, consider fishing to mean catching fish not crabs. Times are changing, however, and crab collection is nowadays seen as rewarding. Thus fishers adopt diversification as way to manage risks associated with their biological and economic environments (Minnegal and Dwyer 2008).

Trust, reciprocity and kinship together constitute another coping strategy that draws on family ties and social networks. To meet immediate crises, such as dowry, fishers most commonly take loans from their relatives. When fishers go to the Sundarbans, they are usually accompanied by their next of kin (e.g. their son, brother or father), who will not leave them if there is any mishap. This trust and loyalty acts as their main security in their fishing operation (Kazim 2011). One fisher from Chandipur underscored the issue:

> During fishing in the forest if a tiger attacks me, my brother will not leave me, and he will fight back to rescue me, and I will do the same in his case. If dacoits kidnap me and one of kin is with me that will give me a feeling that I am not abandoned in the risky forest.

We heard of a number of cases where fellow fishers fought in the forest with a tiger when it attacked one of their fishing mates.

Belief and rituals together make up another strategy to cope with the risk of a tiger attack in the forest. Before going to the forest, traditional Hindu fishers perform various rituals and worship the goddess *Bon Bibi* (Forest Lady) in a way that is different from mainstream Hindu beliefs. There are several statues of the forest goddess *Bon Bibi* scattered throughout the forest for worship by forest-goers. They believe that *Bon Bibi* is always vigilant in the forest to protect them from evil forces and it is she who can offer protection from tigers. This ritual practice and associated beliefs, they feel, provide them with the mental strength to engage in risky fishing practices in the wilderness of the forest.

Coping with income loss by increasing pressure on the fisheries resources is a widespread practice for fishers. Shrimp and prawn postlarvae collection, which is widely practiced by fisherwomen, is considered environmentally destructive, due to loss of

large number of juvenile fish and crustaceans as by-catch. Along with other resource users, some fishers are involved in illegal logging, poaching of wildlife as well as in banned and destructive fishing practices, such as use of poison and catching of undersized and berried species.

For traditional fishers, outmigration was rarely mentioned as a coping strategy, because some fishers feared that it may lead to loss of entitlement to the *khas* land where they are living, even if they do not formally own it. Most fishers think that they have limited capacity to survive if they migrate to other areas. Citing the benefits of common pool resources, one fisherman from Mothurapur said:

> "Here we can stay on *khas* land; if I have no food my child can at least collect some fish. If I go to any city, where I will stay, who will give me food, if I don't have a job for one day?

Finally, outside intervention sometime shapes the coping mechanisms of fishers. After cyclone Aila, there was an influx of governmental, donor and NGOs activities into the areas that brought changes in the livelihoods of fishing communities. Sanitation and drinking water facilities have been improved and rehabilitation activities (like building houses, maintenance of roads and ponds) created temporary job opportunities for many fishers. After encountering relief activities and participating in different awareness programs, most interviewed fishers are now interested in education and concerned to ensure a better future for their children. Some fishers in Chandipur and Dumuria take out micro-credit loans offered by different NGOs to meet immediate needs. Being largely illiterate, they only obtain short-term benefits from these loans, and often become heavily indebted in the long run when they are unable to repay them. Few fishers have savings or insurance schemes as a part of loan arrangements. Cases of fraudulent activities by insurance companies, however, make poor or landless fishers reluctant to be involved in any NGO lending scheme. Instead, they prefer to buy food and other necessities from grocery shops on loan, which they pay off during the peak fishing periods when income is better.

Although the majority of fishers are similarly exposed to shocks, coping heterogeneity exists across poor and better off fishing households (Table 2). The better off fishers are able to elevate their incomes by switching target species by using of different fishing gears (to ward off seasonality and low catch). This adaptive strategy requires, however, financial capital to buy different gears and to cover other ancillary costs, as well as skills that most poor fishers cannot afford or do not possess. Through land ownership, better off fishers could collect a number of material benefits (e.g. bank loans) and non-material benefits (e.g. access to social networks). Hence, a local proverb says "*Kheter kuna*, *durer sona*," which translates to "a small portion of land is more valuable than gold". It is thus not surprising that the majority of the better off fishers were seen to convert their fishing income into land through direct purchase or mortgage. One key informant from Chandipur explained:

> Incomes from forest fishing are diverse and attractive but tend to disappear like a bubble due to the extravagant behavior of fishers. Those who are able to lock their fishing income into land are successful.

Table 2 Key characteristics of poor and better off fishing households in the Sundarbans (Based on interviews with fishers and participant observation)

Poor households	Better off households
i. Fishers work as labour or on profit share schemes without ownership of fishing gears and craft and land.	i. Fishers who have at least homestead land, or if living on *khas* land, have other entitlements to land
ii. Houses are small with thatched roofs	ii. Houses have corrugated GI (galvanised iron) roof sheet
iii. Frequently take loans (*dadon*) for buying food or for other daily expenses	iii. To some extent, have diversified livelihoods outside of fishing
iv. Higher dependency ratios with small children, especially girls	iv. Usually don't take loans or *dadon* for daily expenses
v. Widow headed households without any other active income earners of the family	v. Possess small capital to lend to others on interest
vi. Fishers using inexpensive drag and pull nets for collection of shrimp and prawn postlarvae without any other income source	vi. Have ownership of fishing gears and a boat or involved in the fish trade
vii. Suffer food insecurity on daily or weekly basis; sometime go without one or two meals	vii. Enjoy food security all year round
viii. Youngsters do not go to school but are forced to work by the family out of necessity	viii. Children usually go to school, but if they work, it is for adding income to the family rather than due to dire need
ix. Reciprocal relations mainly exist within own community and relatives but not beyond	ix. Usually have reciprocal relations with people beyond their own communities and with powerful locals

Type of gears and target species are significant in terms of degree of risk during fishing in the forest. Better off fishers usually use more efficient fishing gears and safer fishing methods than poor fishers. Further, in Bangladesh, the local power structure controls the ways the resources and help from the government reach the poor (Lewis and Hossain 2008). Thus, connection to locally powerful elites provides a cushion for the better off during period of crisis. Those who are locally powerful can negotiate by bribing forest officials or giving protection money to dacoits in advance to continue fishing in the forest.

To sum up, fishing households employ a number of coping strategies that include reduction and adjustment of consumption, income diversification through pooling labour and changing gear, illegal fishing, and drawing from mutual insurance and social networks, to mention some (Table 1). Yet, the capacity of a household to cope with the effects of shock exposure depends on the household's productive capacity (e.g. assets, endowments and labour), and family characteristics (dependency ratios), access to social networks, power, and other factors. Unfortunately, as for the poor elsewhere in the world, poor fishing households in the Sundarbans have less of these attributes what means that negative shocks trap them in poverty (cf. Takasaki et al. 2004). This will be discussed further in the next section.

Discussion

Poor people globally are preoccupied with dealing with risks and uncertainty, and their failure to adequately deal with shocks often acts as main cause of their poverty (World Bank 2001). For the poor with lower per capita income, unmitigated shocks can have devastating impacts on their livelihoods (Fafchamps and Lund 2003). This proposition is highly relevant to small-scale fishing households around the world, which are

enmeshed within risk and uncertainty (Béné and Friend 2009). The livelihoods of the small-scale fishers of the Sundarbans are similarly highly prone to shock, which emanates from both risky and non-risky events (Figure 2). This shock exposure is a major cause of poverty (cf. Dercon 2010) and in the Sundarbans it reduces the well-being of the fishers in several ways. For instance, seasonality directly results in low income through loss of fishing days. This manifestation of shock exposes them to further risk (cf. Fafchamps 1999). In the absence of formal health insurance for poor rural fishers, another example of risk exposure is that the death of the main income earner, or his or her chronic illness creates both physiological and economic shocks, which can lead even better off households to bankruptcy and perpetuation of poverty. These observations confirm the findings of Hulme (2004). In the face of income loss, the poor need surplus accumulation to compensate for possible losses, but making savings requires "room to maneuver" (Jentoft and Midré 2011; Clay and Schaffer 1984) that the poor fishers of the Sundarbans simply do not have. The high risk forest environment and certain changes in land usage patterns, such as the expansion of coastal aquaculture activities in their area, put limits on the fishing and living space of poor fishers. Their "room to maneuver" is also restricted due to specific social relationships, such as caste structure and gender relations (cf. Cleaver 2005; Borooah 2005). Women are vulnerable to poverty not only because of their social status, but also because of their role as "shock absorbers" (Mendoza 2009).

In particular, shocks also lead to the exposure to secondary risk as illustrated in Figure 2. These secondary risks are evident in the case of "tiger widows", who after facing the shocking experience of the tragic death of their husband further face the secondary risk of social exclusion and risk of abject poverty. In response to shocks and risks the poor often adopt *ex-post* risk-coping strategies, which only enable them to continue to survive (Figure 2). Yet, a number of coping strategies to reduce shock exposure deepen their precarious conditions. As found in this study, poor fishing households mostly choose to invest in low return peripheral fishing in the Sundarbans and forego higher return on similar investments in deep forest fishing, in order to avoid

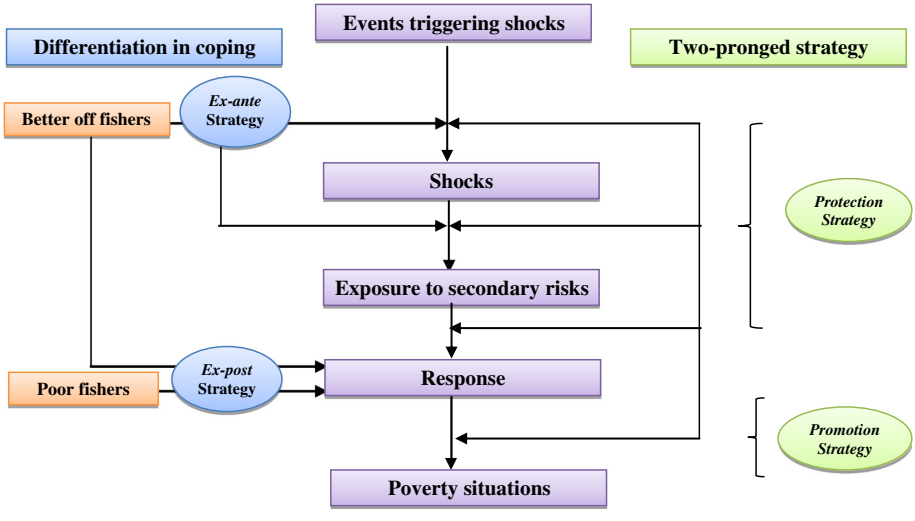

Figure 2 Impacts of risks and shocks on poverty situation and coping and response strategies.

serious hardship and destitution induced by the possible loss of investment (cf. Dercon 2010) by the assault of criminal gangs or the tragic situation created by tiger attack. Taking children out of school, poor nutrition due to reduction in the number of meals and reduction of the quality of meals are some other erosive coping strategies that affect current and future capacity to avert poverty. Better off fishers, on the other hand, employ a different set of strategies, many of which are ex-*ante*, which might not lead to complete eradication of the impacts of shock, but that largely offset them and protect fishers from the exposure to secondary risks (Figure 2). Wealthier fishers are found to develop risk management strategies that are more resilient because they have more diversified and efficient fishing gears and are able to provide bribes and pay extortion where needed. Greater mobility and greater "room to maneuver" in the forest provides them with an income edge over the poor members of the communities, and thus further widens the existing income inequality within the communities.

Recognizing these different responses from better off and poor fishers, we argue for a two pronged approach to interventions, as shown in Figure 2. A protection-oriented component is required to reduce vulnerability to risk exposure, while a promotional component aims to increase income, productivity, or employment prospects (Matin and Hulme 2003; Krishna 2010). Both of these policies are intertwined and reinforce each other. For instance, access to formal bank credit schemes will not only protect households from exploitation by money lenders, but will also promote income generation through investments in productive assets.

Given that seasonality and shocks affect their income and restrict their upward mobility (cf. Krishna 2010), fishers need to be protected from events that erode their income. Some key informants perceive that although complete elimination of the sources of risk may not be possible, some risk events are manipulated by human activities and are negotiable. Ironically, most fishers said that criminal gangs of dacoits are more harmful than tigers. Most fishers complain they are tired of having to meet the extortion and ransom demands to get access to fishing. So it is imperative to provide them "protective security" (Sen 1999), through, among other things, better governance. The national law of Bangladesh formally favors landless people to get access to government owned *khas* land, but acquisition is largely discriminatory and the processes bear potential for conflicts with local landlord elites. Secure ownership of *khas* land in a suitable setting should be a priority for livelihood strengthening of poor fishing households. Considering the limited feasibility of insurance schemes by private enterprises, public micro-insurance of all legal fishing practices can be an effective strategy. A small premium could be taken when fishing permits are issued. This will also encourage fishers to practice legal fishing, which will reduce illegal and over exploitation of resources as well as serve as a buffer against sudden shocks. Having buffers and protective security will reverse risk averse behaviour of poor fishers to a certain extent and that, in turn, will boost their capacity to take on more risky but higher-return fishing activities in the forest. However, such changes of attitude need to be promoted by endowing fishers with socio-economical capitals.

In terms of promotion, raising income is not all that is required for risk management and reduction of poverty for small-scale fishers, it is also urgent to enhance the set of livelihood choices for risk spreading. Considering the diverse sources of risks women face and their history of job multiplication, land based job opportunities for women

need to be promoted. Shifting the occupation of fisherwomen from forest fishing (particularly environmentally destructive shrimp and prawn postlarvae collection activities) would help to take pressure off the forest and also to reduce high dependency of entire households on vulnerable fisheries and uncertain incomes (cf. Takasaki et al. 2004). More importantly, to prevent intergenerational continuities of poverty, more effective *ex-ante* and *ex-post* mechanisms are required (Santos 2010). Our study identified some promising outside interventions after cyclone Aila. Now (2011) in Chandipur, about eighty percent of children (5 years of age or older) go to school whereas only 5 percent of adult fishers (+30 years) have five years of schooling. The government now gives monthly allowances to students in primary school. Particularly, the present study observed that school feeding programs, that provide nutritious biscuits to students, have positive impacts on school attendance. Given limited means and resources, targeting support is probably the most efficient solution (Dercon 2005). Following this policy, vulnerable fishing households need to be brought into the social safety net through, for example, enrolling them in the existing Vulnerable Group Feeding program which is targeted to vulnerable people in society. Most lower caste poor fishers suffer from a lack of interaction and diversity both in terms of their fishing group as well as in mixing with other communities. As a result they suffer social exclusion. This kind of segregation bars them from participation in the social and economic growth opportunities in the area (cf. Crona and Bodin 2006) and inhibits them from exploring new opportunities. Again, in the longer term, eradication of rural poverty is only possible by economic development (Fafchamps 1999). Hence, it is important to bring fishers into mainstream development processes, recognizing their different coping mechanisms, and including them in delineating risk management options. This implies that it is crucial to provide them access to education, skills, healthcare, information, and credit, which will increase their opportunity to share in societal wealth creation (Dercon 2010; Takasaki et al. 2004).

Conclusion

In this paper, we examine the risks and shocks faced by the fishers of the Sundarbans, how they cope with risk exposure and shocks, what factors differentiate them in their adaptive capacity, and what implications differential capacity may have on their poverty situations. Our study shows that small-scale fishers in the Sundarbans face disruptive shocks that are numerous, severe, and widespread and that this shock exposure is a major driver that pushes or entraps them in poverty. In responding to shock exposure, fishing households in the Sundarbans have developed a number of strategies which are diverse and vary according to asset ownership. Yet, in absence of any effective buffer, frequent shocks create deprivation among poor fishers who are thus not able to employ sound coping strategies. On the other hand, the adaptive strategies of better off fishers are more effective. This finding suggests that holding socio-economic assets is a key tool to guard against shocks and differentiates among the capacities of fishers to cope with or negotiate risk and shock impacts. Under such conditions, our study submits that reducing risk and shock exposure should be at the core of poverty reduction efforts for Sundarbans fishing communities. For instance, better off households in the Sundarbans may not be poor today, but recurrent exposure to shock can push them rapidly into poverty, because they might survive one shock but not recurrent shocks.

Thus poverty alleviation strategies should aim at not only lifting the shock-ridden poor out of poverty, but also to protect risk-vulnerable (better off) fishers from getting into poverty. Hence, our study argues for a two-pronged strategy of protection and promotion to contain the risk factors in the household's environment, to mitigate the household's exposure to shock and to strengthen its capacity to cope with and manage risk exposure.

Endnotes

[a]The Vulnerable Group Feeding (VGF) program in Bangladesh is a relief program that is usually initiated during or after a disaster to support the affected people who are vulnerable to hunger.

[b]Union Council is the lowest tier of the three-tiered local administration in Bangladesh.

[c]A member of a land-based robber gang.

[d]This three wheeled human hauler (different than a rickshaw) is a widely used means of transportation in the study areas for passengers and goods.

[e]Seven is the symbolic number for many.

[f]Women and girls are reported to have gynecological problems after spending prolonged periods in water; risk of crocodile attack is also reported.

Competing interests
The authors declare that they have no competing interests.

Authors' contributions
MMI and RC shared responsibility in conceptualization of research questions. MMI was responsible for fieldwork, data analysis and preparation of manuscript. RC provided input to the structure of the manuscript and helped read and revise it. All authors read and approved the final manuscript.

Acknowledgements
Funding for this research of the first author including his empirical research was provided by the Bremen International Graduate School for Marine Sciences (GLOMAR). The idea for the paper was developed during the visit of the first author to International Coastal Network, Memorial University, Canada, where the second author is located. The manuscript has benefited from comments of Michael Flitner from the University of Bremen, Germany and Maritime Studies Editor Derek Johnson. We are grateful to two anonymous reviewers for their very helpful comments.

Author details
[1]Bremen International Graduate School for Marine Sciences (GLOMAR), Research Center for Sustainability Studies (artec), University of Bremen, Bremen 28359, Germany. [2]International Coastal Network, Department of Geography, Memorial University of Newfoundland, St. John's, NL A1B 3X9, Canada.

Received: 17 April 2013 Accepted: 17 April 2013
Published: 28 June 2013

References

Allison, EH, AL Perry, M-C Badjeck, WN Adger, K Brown, D Conway, AS Halls, GM Pilling, JD Reynolds, NL Andrew, and NK Dulvy. 2009. Vulnerability of National Economies to the Impacts of Climate Change on Fisheries. Fish Fish 10: 173–196.

Andrade, H, and G Midré. 2011. The Merits of Consensus: Small-Scale Fisheries as a Livelihood Buffer in Livingston, Guatemala. In Poverty Mosaics: Realities and prospects in Small-scale Fisheries, ed. S Jentoft and A Eide, 427–448. Dordrecht Springer.

Asian Development Bank. 1998. Summary of Initial Environmental Examination for Sundarbans Biodiversity Conservation Project in Bangladesh. Asian Development Bank. http://www.adb.org/documents/environment/ban/ban-sundarbans.pdf, Accessed August 23, 2011.

Baulch, B, and P Davis. 2008. Poverty Dynamics and Livelihood Trajectories in Rural Bangladesh. International Journal of Multiple Research Approaches 2(2): 176–190.

Béné, C, and RM Friend. 2009. Water, Poverty and Inland Fisheries: Lessons from Africa and Asia. Water International 34(1): 47–61.

Borooah, VK. 2005. Caste, Inequality and Poverty in India. Rev Dev Econ 9: 399–414.

Cashdan, EA. 1985. Coping with Risk: Reciprocity among the Basarwa of Northern Botswana. Man New Series 20(3): 454–474.

Chambers, R. 2006. Editorial Introduction: Vulnerability, Coping, and Policy. IDS Bull 37(4): 33–40.

Chaudhuri, S, J Jalan, and A Suryahadi. 2002. Assessing Household Vulnerability to Poverty from Cross-Sectional Data: A Methodology and Estimates from Indonesia. Department of Economics, Columbia University, New York. Discussion Papers 0102–52.

Chuenpagdee, R, and K Juntarashote. 2011. Learning from the Experts: Attaining Sufficiency in Small-Scale Fishing Communities in Thailand. In Poverty Mosaics: Realities and prospects in Small-scale Fisheries, ed. S Jentoft and A Eide, 309–331. Dordrecht Springer.

Clay, EJ, and B Schaffer. 1984. Conclusion: Self Awareness in Policy Practice. In Room for Manoeuvre: An Explorafion of Public Policy in Agricuhural and Rural Development, ed. EJ Clay and B Schaffer, 191–193. Cranbury, New Jersey: Heinemann.

Cleaver, F. 2005. The Inequality of Social Capital and the Reproduction of Chronic Poverty. World Dev 33(6): 893–906.

Crona, B, and Ö Bodin. 2006. What You Know is Who You Know? Communication Patterns among Resource Users as a Prerequisite for Co-management. Ecol Soc 11(2): 1–7.

Dercon, S. 2002. Income Risk, Coping Strategies, and Safety nets. World Bank Research Observer 17(2): 141–166.

Dercon, S. 2005. Risk, Poverty and Vulnerability in Africa. Journal of African Economics 14(4): 483–488.

Dercon, S. 2006. Vulnerability: A Micro-perspective. In Annual World Bank Conference on Development Economics-Europe: Securing development in a unstable world, ed. F Bourguignon, B Pleskovic, and J van der Gaag, 117–145. The World Bank, Washington, D.C.

Dercon, S. 2010. Risk, Vulnerability and Human Development: What We Know and What We Need to Know? In Risk, Shocks, and Human development: On the brink, ed. R Fuentes-Nieva and P Seck, 13–35. Basingstoke: Palgrave Macmillan.

Dercon, S, J Hoddinott, and T Woldehanna. 2005. Shocks and Consumption in 15 Ethiopian villages, 1999–2004. J Afr Econ 14(4): 559–585.

Edvardsson, IR, D Tingley, AJ Conides, B Drakeford, and D Holm. 2011. Fishermen's risk perception in four European countries. Maritime Studies 10(1): 139–159.

Fafchamps, M. 1999. Rural Poverty, Risk, and Development. Center for the Study of African Economies. Oxford: University of Oxford.

Fafchamps, M, and S Lund. 2003. Risk-Sharing Networks in Rural Philippines. J Dev Econ 71(2): 261–287.

Hoddinott, J, and A Quisumbing. 2010. Methods for Microeconometric Risk and Vulnerability Assessment. In Risk, shocks, and human development: On the brink, ed. R Fuentes-Nieva and P Seck, 62–94. Basingstoke: Palgrave Macmillan.

Hoogeveen, J, E Tesliuc, R Vakis, and S Dercon. 2004. A Guide to the Analysis of Risk, Vulnerability and Vulnerable Groups. Social Protection Unit, Human Development Network, The World Bank. http://siteresources.worldbank.org/INTSRM/Publications/20316319/RVA.pdf, Accessed November 1, 2009.

Hoq, ME. 2007. An analysis of Fisheries Exploitation and Management Practices in Sundarbans Mangrove Ecosystem. Bangladesh. Ocean & Coastal Management 50: 411–427.

Hossain, N. 2009. Accounts of Crisis: Poor People's Experiences of the Food, Fuel and Financial Crises in Five Countries. Report on a pilot study in Bangladesh, Indonesia, Jamaica, Kenya and Zambia. London: Institute of Development Studies.

Hulme, D. 2004. Thinking 'Small' and the Understanding of Poverty: Maymana and Mofizul's story. J Hum Dev 5(2): 161–176.

Islam, MS, and MA Wahab. 2005. A Review on the Present Status and Management of Mangrove Wetland Habitat Resources in Bangladesh with Emphasis on Mangrove Fisheries and Aquaculture. Hydrobiologia 542(1): 165–190.

Jentoft, S, and G Midré. 2011. The Meaning of Poverty: Conceptual Issues in Small-scale Fisheries Research. In Poverty Mosaics: Realities and Prospects in Small-scale Fisheries, ed. S Jentoft and A Eide, 43–68. Dordrecht: Springer.

Kazim, H. 2011. The Outcasts: Bangladesh's Tiger Widows Fight Exclusion. Spiegel Online. http://www.spiegel.de/international/world/0,1518,744594,00.html, Accessed October 2, 2011.

Khuda, ME. 2008. Transparency and Accountability in Forest Conservation and Management: Problems and Way Out. Executive Summary. Dhaka: Transparency International Bangladesh.

Kissling, E, EH Allison, JA Seeley, S Russell, M Bechmann, SD Musgrave, and S Heck. 2005. Fisherfolk are Among Those Most at Risk to HIV: A Cross-country Comparison of Estimated Prevalence and Numbers Infected among Groups at Risk. AIDS 19: 1939–1945.

Krishna, A. 2010. One Illness Away. Why People Become Poor and How they Escape Poverty. Oxford: Oxford University Press.

LEDARS. 2010. Tiger Widows-A Hidden Issue in the Sundarbans. Tiger Widow Newsletter. http://www.ledars.org/livelihood_security_program.php, Accessed October 2, 2011.

Lewis, D, and AA Hossain. 2008. Tale of Three Villages: Power, Difference and Locality in Rural Bangladesh. Journal of South Asian Development 3(1): 33–51.

Lincoln, JM, DS Hudson, GA Conway, and R Pescatore (eds.). 2002. Proceedings of the International Fishing Industry Safety and Health Conference. Woods Hole, Massachusetts: Department of Health and Human Services.

Matin, I, and D Hulme. 2003. Programs for the Poorest: Learning from the IGVGD Program in Bangladesh. World Dev 31(3): 649–667.

Mendoza, RU. 2009. Aggregate Shocks, Poor Households and Children: Transmission Channels and Policy Responses. Global Social Policy 9: 55–78.

Minnegal, M, and PD Dwyer. 2008. Managing risk, resisting management: stability and diversity in a southern Australian fishing fleet. Hum Organ 67: 97–108.

Mitra, M. 2000. The Sundarbans: A Riparian Commons in Search of Management. Eighth Conference of the International Association for the Study of Common Property. IN, USA: Bloomingdale.

Morduch, J. 1995. Income and Consumption Smoothing. J Econ Perspect 9(3): 103–114.

Morduch, J. 1999. Between the state and the market: Can informal insurance patch the safety net? The World Bank Research Observer 14(2): 187–207.

Mosley, P, and A Verschoor. 2005. Risk attitudes and the 'Vicious Circle of Poverty'. Eur J Dev Res 17(1): 59–88.

Quisumbing, A, R Meinzen-Dick, and L Bassett. 2008. Helping Women Respond to the Global Food Price Crisis. IFPRI Policy Brief 7. Washington, DC: IFPRI.

Rosenzweig, M, and H Binswanger. 1993. Wealth, Weather Risk and the Composition and Profitability of Agricultural Investments. Econ J 103: 56–80.
Rouf, MA, and KR Jensen. 2001. Coastal Fisheries Management and Community Livelihood: Possible Strategy for the Sundarbans, Bangladesh. Thailand: ITCZM Monograph No. 04.
Salas, S, M Bjørkan, F Bobadilla, and MA Cabrera. 2011. Addressing Vulnerability: Coping Strategies of Fishing Communities in Yucatan, Mexico. In Poverty Mosaics: Realities and Prospects in Small-scale Fisheries, ed. S Jentoft and A Eide, 195–220. Dordrecht: Springer.
Santos, VI. 2010. The Effects of Earthquakes on Children and Human Development in Rural El Salvador. In Risk, shocks, and human development: On the brink, ed. R Fuentes-Nieva and P Seck, 1128–1144. Basingstoke: Palgrave Macmillan.
Sen, A. 1999. Development as Freedom. Oxford: Oxford University Press.
Sinha, S, M Lipton, and S Yaqub. 2002. Poverty and "Damaging Fluctuations": How do they relate? Journal of Asian and African Studies 37(2): 186–243.
Smith, ME. 1998. Fisheries Risk in Modern Context. Maritime Anthropological Studies 1: 29–48.
Tai, X, S Li, MW Feldman, GC Daily, and J Li. 2010. Rural Households' Risks Management Strategies and Vulnerability to Poverty in Western Rural China. Montpellier: ISDA. http://www.isda2010.net/var/isda2010/storage/original/application/aeb7d95cb639bb08a017c5d311fc0085.pdf, Accessed November 1, 2009.
Takasaki, Y, BL Barham, and OT Coomes. 2004. Risk Coping Strategies in Tropical Forests: Floods, Illnesses, and Resource Extraction. Environ Dev Econ 9: 203–224.
The Royal Society. 1992. Risk: Analysis, Perception and Management. London: The Report of a Royal Society Study Group.
Tingley, D, J Asmunsson, E Borodzicz, A Aonides, B Drakeford, IR Eovarosson, D Holm, K Kapiris, S Kuikka, and B Mortensen. 2010. Risk Identification and Perception in the Fisheries Sector: Comparisons between the Faroes, Greece, Iceland, and UK. Marine Policy 34(6): 1249–1260.
UNDP. 2007. Fighting Climate Change: Human Solidarity in a Divided World, Human Development Report. http://hdr.undp.org/en/media/HDR_20072008_EN_Complete.pdf, Accessed November 1, 2009.
Webb, P, and A Harinarayan. 1999. A Measure of Uncertainty: The Nature of Vulnerability and its Relationship to Malnutrition. Disasters 23(4): 292–305.
WFP (World Food Programme). 2009. Pilot Monitoring of High Food Price Impact at Household Level in Selected Vulnerable Areas. Indonesia: Mimeo.
World Bank. 2001. World Development Report 2000/2001: Attacking Poverty. Oxford and New York: Oxford University Press.

doi:10.1186/2212-9790-12-7
Cite this article as: Islam and Chuenpagdee: **Negotiating risk and poverty in mangrove fishing communities of the Bangladesh Sundarbans.** *Maritime Studies* 2013 **12**:7.